LOCKE INSULATORS®

Locke Insulators, Inc.
2525 Insulator Drive
Baltimore, Maryland 21230
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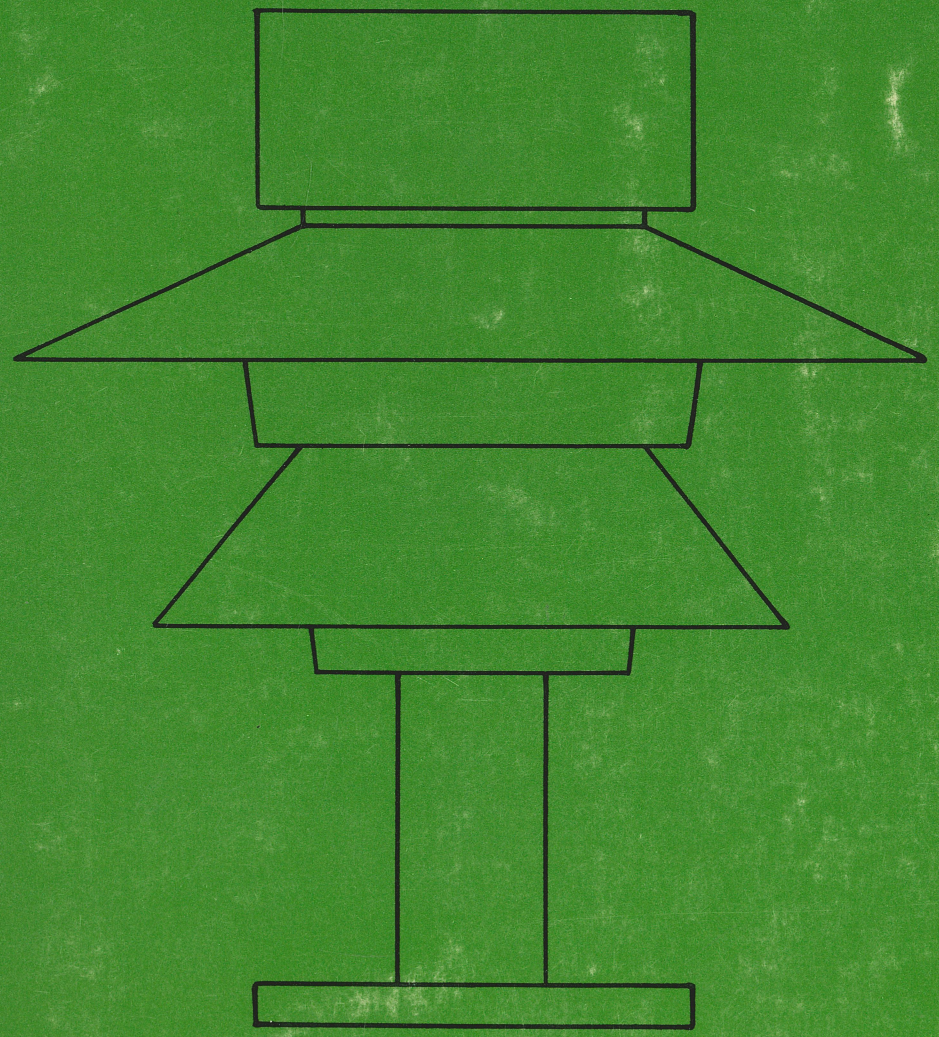
Catalog No. 762

LOCKE
SWITCH and BUS INSULATORS
CAP and PIN TYPE



LOCKE INSULATORS® • BALTIMORE, MARYLAND

CONTENTS Page

Construction details .1
Design features 2
Application information 2, 3
Basic impulse levels 4
Cantilever strength .5
Horizontal mounting 5
Standard strength units 6
High strength units .7
Stacking units 8, 9
Stack characteristics 10, 11

SWITCH and BUS INSULATORS

GENERAL INFORMATION

Locke wet-process porcelain insulators for outdoor switches, bus supports and similar applications are designed and made to give long life and trouble free operation.

All switch and bus insulators are furnished in accordance with ANSI Standard C-29.8-1971 unless otherwise specified. These standards cover the methods of testing to check ratings, as well as the ratings of the individual units.

We strongly recommend that ANSI standard switch and bus insulators be used wherever it is possible to do so. There are many good reasons for this:

a. The number of insulators that the manufacturer must carry in stock is greatly reduced. Also, users can carry a smaller stock of replacement insulators.

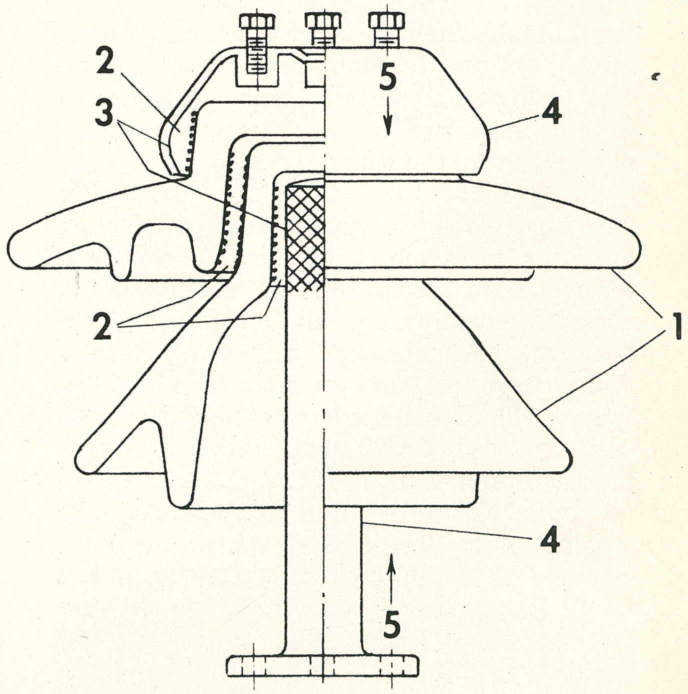
b. The use of standard insulators gives the switch builder greater latitude in design with the use of a smaller number of insulators.

c. Standard insulators cost less. We are equipped to produce large numbers of high grade standard units. A change in design, even a very small one, will often result in increased costs and increased prices.

It is appreciated, of course, that there are times when insulators not built to ANSI standards must be used. Should there be a requirement for such units, consult Locke for your requirements.

CONSTRUCTION DETAILS

1. Proven design and manufacturing techniques provide finest quality porcelain, compression glazed, to give high mechanical and electrical strength.
2. Assembly of hardware and porcelain components is made with neat Portland cement, steam cured under controlled conditions to achieve optimum physical properties. Special sanded surfaces, developed by engineering research, provide reliable gripping areas on the porcelains to develop the full strength of the assemblies.
3. To relieve thermal stresses and assist in the distribution of working loads between stressed members, a permanently flexible coating is applied to the hardware components, separating the metal and cement. This coating also prevents any chemical reaction between cement and hardware.
4. The insulator caps and pins are made from the finest malleable iron or low carbon steel. All hardware is hot dip galvanized providing a sound uniform zinc layer on all metal surfaces. Galvanizing exceeds requirements established under ASTM specifications.
5. All insulators are jig assembled to assure proper alignment of bolt holes, uniform height and parallel mounting surfaces.



DESIGN FEATURES

The reliability and proven performance of cap and pin switch insulators is attested by the great numbers of these units in service. Standardization of units having a wide range of use has greatly simplified the problem of selection for any particular application. Standard strength insulators are available for each circuit voltage class from 7.5 kV to 500 kV. In addition, high strength units having greater mechanical strength are available for specialized needs. Above 69 kV, only one insulator unit is required to build stacks for all voltages accomplishing maximum interchangeability and minimum stock. Combinations of insulators in high voltage stacks can also be employed, providing necessary cantilever strength at maximum economy.

Most cap and pin insulators are formed of two or more shells nested together to achieve optimum electrical characteristics. In this type construction, each individual shell can be thoroughly inspected and tested prior to assembly. Also greater uniformity and homogeneity of the porcelain shells can be obtained in all manufacturing operations, enhancing the physical properties of the insulator.

Breaking the shell of a multi-shell insulator in service will not normally result in an outage. The remaining portion will continue to support apparatus and insulate system voltage until the insulator can be replaced.

The high dielectric strength of a multi-shell insulator is achieved by reliable porcelain barriers, each having been thoroughly tested prior to assembly. It will generally perform better in contaminated areas where surface dirt reduces the flashover of an insulator. The large shells of different diameters of the cap and pin insulator provide more protected leakage distance and larger drip paths preventing bridging across the air gaps by drip streams. The wider spacing permits easy cleaning by wind and rain and shells are less likely to trap dirt or other contaminants than closely spaced hoods. Rain shields are not required to break up drip streams over the surface of the insulator and small angles of vertical misalignment have little effect upon the wet flashover performance.

Ideally, the positive and negative impulse flashover of an insulator should be identical, particularly for switch applications. Cap and pin switch insulators approach this characteristic better than other types of switch units, providing maximum safety in a switch of minimum dimensions. Lower unit weights of the switch insulator permit greater ease in assembly and installation. For high impact loads, the flexibility of the cap and pin insulator provides for increased shock absorption with less risk of damage.

APPLICATION INFORMATION

The Technical Reference Number (TR No.) is an ANSI identification for an insulator unit or stack with prescribed characteristics.

Tests are conducted in accordance with ANSI C-29.1-1961 or latest revision. Flashover and withstand ratings on cap and pin types include the use of subbases with the insulators, if they are commonly used to develop full electrical values.

Functionally, a switch or bus insulator must fulfill certain basic requirements:

a. Support the required mechanical loads in cantilever, torsion, tension, and compression.

b. Have adequate dielectric strength to prevent puncture.

c. Provide a sufficient air gap to give the required flashover characteristics.

d. Provide sufficient surface leakage to permit operations under normal conditions of atmospheric contamination.

Switch and bus insulators are divided into stacking and non-stacking units. Stacking units are designed to develop higher cantilever strength and greater rigidity when used in tall stacks. Conventional cap and pin standard units rated up through 46 kV are non-stacking.

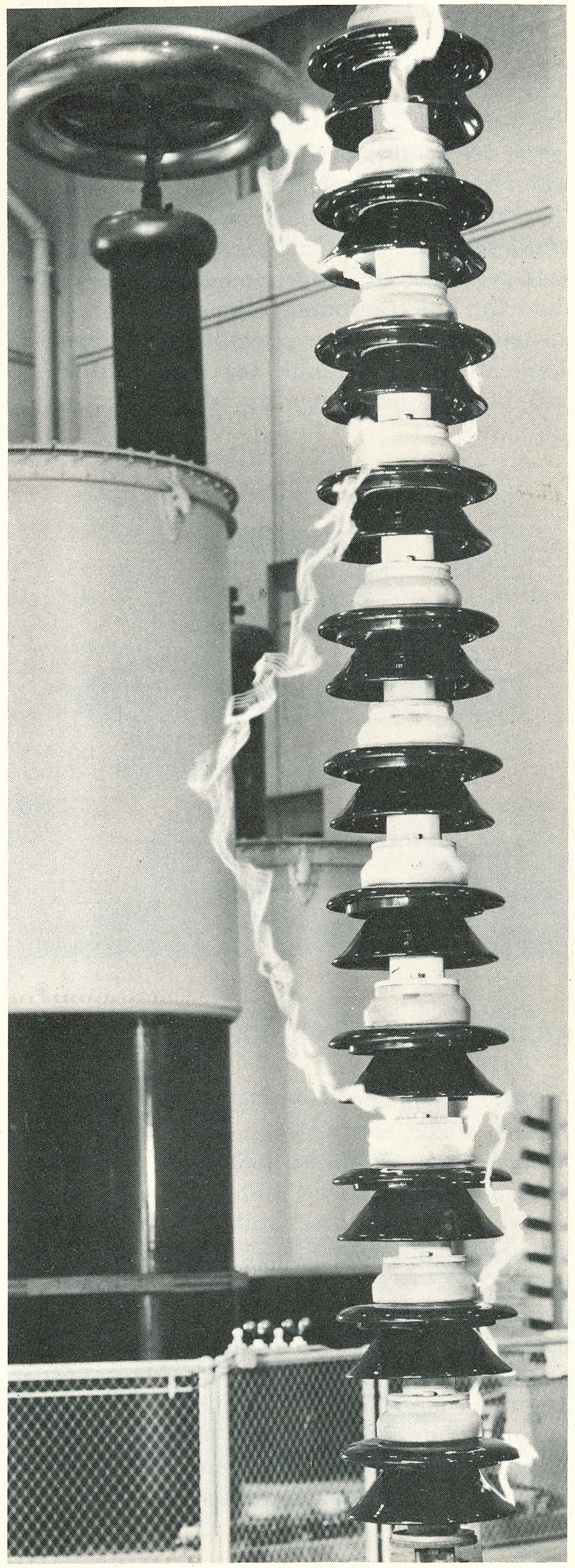
Mounting holes in hardware are drilled on 3", 5", or 7" diameter bolt circles. Threaded holes are tapped 0.015" oversize so that standard galvanized steel bolts may be used.

When conductor connections are made between switch and bus insulators connected to heavy apparatus, such as transformer or circuit breaker bushings, sufficient flexibility and slack should be provided to allow for differential settling of structures and thermal changes.

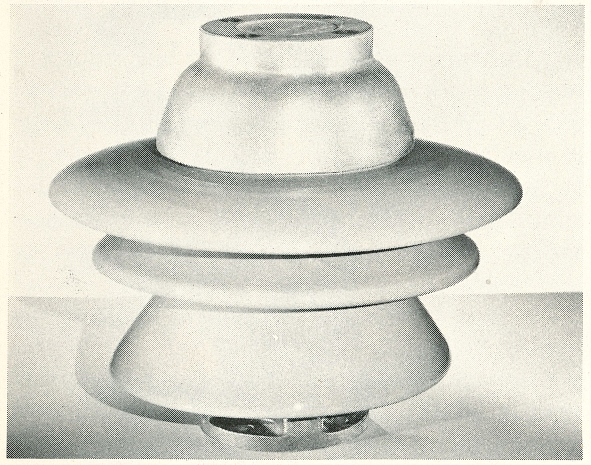
The maximum recommended working load on any of the switch and bus insulator characteristics is 40% of the rated ultimate strength as published in the tabulations.

The deflection information shown in the Stack Characteristics is given as inches per 100 lbs. The relationship of deflection to load within the recommended working load is linear and therefore can be calculated for any load. For example on TR 19 the deflection is .034 inches per 100 lbs., and at 500 lbs. of load the deflection would be .034 x 5 or .170 inches.

Locke cap and pin type switch and bus insulators comply with ANSI standards for radio noise free insulators. The elimination of radio noise on some types of switch and bus insulators calls for a semi-conducting layer on the porcelain surface. This is accomplished by the use of Metaglaze which contains metallic oxides in precise proportion, to obtain specific high-resistance properties. This glaze is applied on the desired areas only, under the regular glaze. The pyro-chemical reactions of firing cause thorough binding and result in superior radio-interference characteristics unaffected by exposure, chemical fumes, abrasion, even sandblasting of portions of the conducting area. Here too, glaze thickness control is essential, as resistivity varies with glaze thickness. Automatic glazing machines safeguard this important element of insulator quality.



The radio interference values in the tables apply only to new switch and bus insulators tested in the factory, and are the maximum permissible microvolt ratings when tested at the indicated test voltage to ground. Tests are made in accordance with current NEMA—EEI—RMA recommendations on methods of measuring radio noise, ANSI C-29.1-1961, or latest revision. The low frequency RMS test voltage values are approximately 10% higher than the line to ground voltage at which these insulators are usually operated. In apparatus applications, the limits for these insulators will be established by the standards of the apparatus.



BASIC IMPULSE INSULATION LEVEL

A basic insulation level (BIL) is the impulse voltage which electrical equipment is required to withstand without failure or disruptive discharge, when tested under specified conditions of temperature and humidity. Basic impulse insulation levels are designated in terms of the crest voltage of a 1.2 x 50 microsecond full wave impulse voltage test wave. These levels are subject to continuing study by a joint IEEE—NEMA committee, as new concepts and additional data on system grounding practices, maximum operating voltages and equipment with reduced insulation levels, are developed.

Because of the many different factors affecting the choice of basic insulation level (BIL) in the insulation of a modern power system, the relationship between system operating voltage and BIL may vary. For example, a 230 kV switch may have a BIL of 900 kV or 1050 kV. It is recommended that the selection of insulator units and stacks in modern station design be based on the basic insulation level rather than on the system operating voltage.

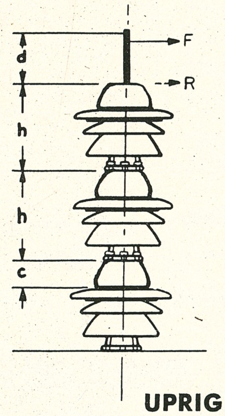
As a guide for selection, the tabulation shows the relationship between BIL and system voltage which has been typical of past engineering practice.

BIL*	Nominal System Voltage
30	1.2
45	2.5
60	4.8
75	7.2
95	7.2, 8.3, 13.2
110	14.4
150	23
200	34.5
250	46
350	69
450	92, 115
550	115, 138
650	138, 161
750	161
825	230
900	230
1050	230, 287
1300	287, 345
1425	460

*Expressed in kV crest value of withstand voltage of a 1.2 x 50 microsecond full impulse wave.

CANTILEVER STRENGTH

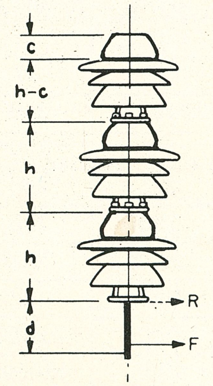
Cantilever strength is often critical in insulator application. All cantilever ratings shown in the tables assume that the load is applied flush with cap or pin. If cantilever loads are applied at any other point, the allowable load at that point will vary inversely as the effective moment arm. The normal fracture location under cantilever loading is near the lip of the cap of the unit at the supported end of the stack. Fig. 1 illustrates a method for calculating cantilever strength in such cases. These formulae should be used *only* for stacks of two or more units. For special applications or single units of stacking insulators, refer to factory for recommendations.



R=RATED UPRIGHT CANTILEVER STRENGTH
F=CANTILEVER STRENGTH FOR LOADS APPLIED AT DISTANCE "d" ABOVE TOP OF CAP
h=UNIT HEIGHT
c=CAP HEIGHT
n=NUMBER OF UNITS IN STACK

$$F = R\left[\frac{(n-1)h+c}{(n-1)h+c+d}\right]$$

UPRIGHT MOUNTING



R=RATED CANTILEVER STRENGTH
F=CANTILEVER STRENGTH FOR LOADS APPLIED AT DISTANCE "d" BELOW BASE OF INSULATOR
h=UNIT HEIGHT
c=CAP HEIGHT
n=NUMBER OF UNITS IN STACK

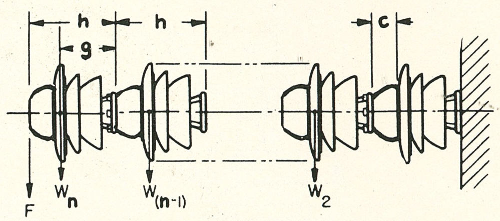
$$F = R\left[\frac{nh-c}{nh-c+d}\right]$$

UNDERHUNG MOUNTING

Figure 1

HORIZONTAL MOUNTING

In horizontal mounting of multiple unit stacks, the bending moment imposed on the base unit by the weight of the other units may form a large portion of the allowable rated moment. Fig. 2 shows a method of calculating external load which can be carried by a stack of units in horizontal position.



R—RATED CANTILEVER STRENGTH
F—RESIDUAL CANTILEVER STRENGTH AVAILABLE FOR SUPPORT OF EXTERNAL LOAD
n—NUMBER OF UNITS IN STACK
h—HEIGHT OF UNIT
c—HEIGHT OF CAP
g—DISTANCE OF CENTER OF GRAVITY OF EACH UNIT ABOVE ITS BASE (60% of h)
$W_1, W_2, W_3 \ldots W_n$=WEIGHTS OF INDIVIDUAL UNITS COUNTING FROM GROUND END

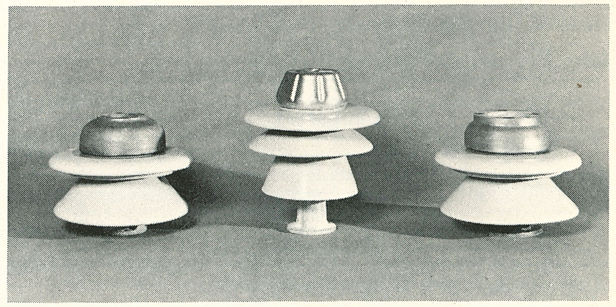
$$F = \frac{R[(n-1)h+c]-W_2(g+c)-W_3(g+c+h)---W_n[g+c+(n-2)h]}{(n-1)h+c}$$

IF ALL UNITS HAVE THE SAME WEIGHT THEN

$$W_2 = W_3 = \ldots\ldots W_n = W$$

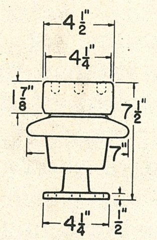
$$\text{AND } F = \frac{R[(n-1)h+c]-W(n-1)\left[\frac{(n-2)h}{2}+g+c\right]}{(n-1)h+c}$$

Figure 2

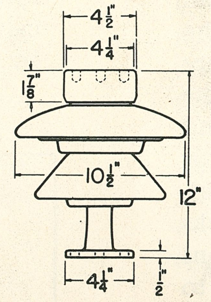


SWITCH and BUS INSULATORS

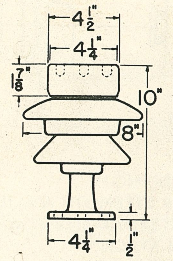
INDIVIDUAL UNITS
Standard Strength



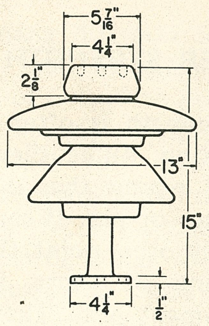
TR No. 1
29200



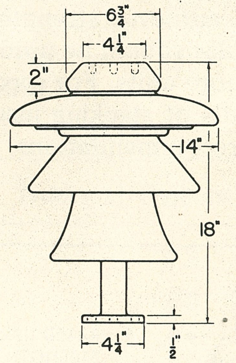
TR No. 7
29251



TR No. 4
29250



TR No. 10
29455



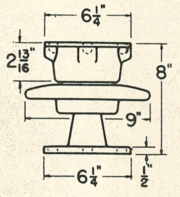
TR No. 13
29153

All caps have four ½" + .015" — 13 UNC-2 tapped holes on 3" bolt circle. Cap screws are not supplied.
All pins have four 9/16" diameter holes on 3" bolt circle.
Insulators will be supplied with light gray compression glaze unless specifically ordered with brown glaze.

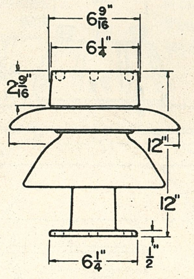
Locke Catalog Number			29200	29250	29251	29455	29153
Technical Reference Number			1	4	7	10	13
BIL Impulse Withstand Voltage, kV			95	110	150	200	250
Suggested Voltage Rating, kV			7.5	15.	23.	34.5	46.
Leakage Distance, in.			7½	12	20	28	36
Radio Influence Voltage	Test kV to Ground		5	10	15	22	30
	Max. μV at 1000 kHz		50	50	100	100	200
Low Frequency Withstand Voltage, 10 seconds, wet, kV			30	45	60	80	100
Critical Impulse Flashover, Positive, kV			105	125	170	225	280
Low Frequency Puncture Voltage, kV			80	115	145	195	225
Mechanical Strength	Cantilever	Upright, lb	2000	2000	2000	2000	2000
		Underhung, lb	1000	1000	1000	1000	1000
	Torsion, in. - lb		6000	7000	8000	10000	12000
	Tension, lb		5000	5000	5000	7000	8000
	Compression, lb		10000	10000	10000	15000	15000
Approximate Net Weight Each, lb			11	16	25	38	54
Standard Package Quantity			6	4	3	2	1

SWITCH and BUS INSULATORS

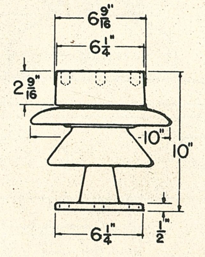
INDIVIDUAL UNITS
High Strength



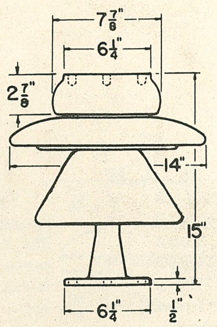
TR No. 41
30200



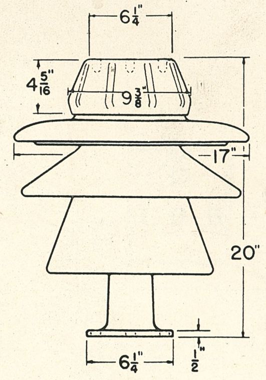
TR No. 46
30251



TR No. 44
30250



TR No. 49
30455



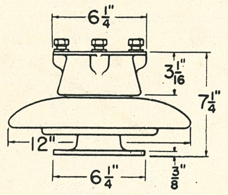
TR No. 53
30153

All caps have four 5/8" + .015-11 UNC-2 tapped holes on 5" bolt circle. Cap screws are not supplied.
All pins have four 11/16" holes on 5" bolt circle.
Insulators will be supplied with light gray compression glaze unless specifically ordered with brown glaze.

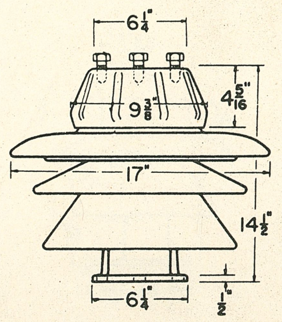
Locke Catalog Number			30200	30250	30251	30455	30153
Technical Reference Number			41	44	46	49	53
BIL Impulse Withstand Voltage, kV			95	110	150	200	250
Suggested Voltage Rating, kV			7.5	1.5	23.	34.5	46.
Leakage Distance, in.			8	14	18	28	40
Radio Influence Voltage	Test kV to Ground		5	10	15	22	30
	Max. μV at 1000 kHz		50	50	100	100	200
Low Frequency Withstand Voltage, 10 seconds, wet, kV			30	45	60	80	100
Critical Impulse Flashover, Positive, kV			105	125	170	225	280
Low Frequency Puncture Voltage, kV			90	115	145	195	225
Mechanical Strength	Cantilever	Upright, lb	4000	4000	4000	4000	4000
		Underhung, lb	3000	3000	3000	3000	2500
	Torsion, Inch lb		12000	14000	16000	20000	20000
	Tension, lb		10000	10000	10000	14000	15000
	Compression, lb		20000	20000	20000	30000	30000
Approximate Net Weight Each, lb			23	31	36	55	88
Standard Package Quantity			4	4	2	2	1

SWITCH and BUS INSULATORS

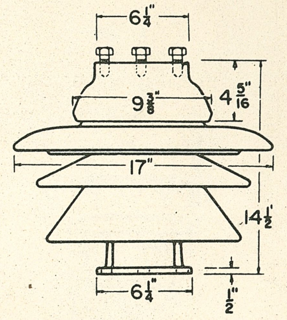
STACKING UNITS



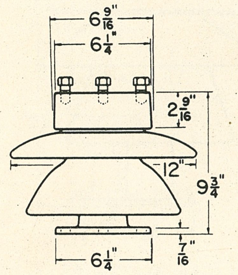
TR No. 58
32200



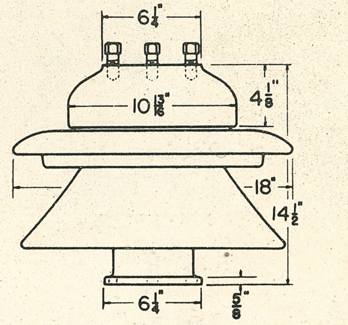
TR No. 140
7785



TR No. 139
23333



TR No. 145
8888



TR No. 141
23082

All caps have four 5/8" + .015-11UNC-2 tapped holes on 5" bolt circle. Four cap screws are supplied.

All pins have four 11/16" diameter holes on 5" bolt circle.

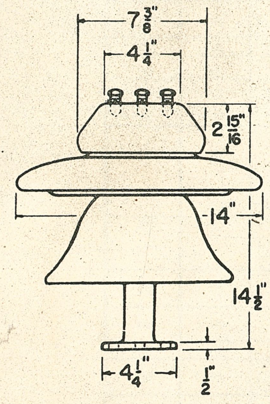
Insulators will be supplied with light gray compression glaze unless specifically ordered with brown glaze.

Locke Catalog Number			32200	8888	7785	23333	23082
Technical Reference Number			58	145	140	139	141
BIL Impulse Withstand Voltage, kV			95	140	210	210	210
Leakage Distance, Inches			13½	18	33	33	33
Radio Influence Voltage	Test kV to Ground		5	15	22	22	22
	Max µV at 1000 kHz		50	100	100	100	100
Low Frequency Withstand Voltage, 10 seconds, wet, kV			30	45	75	75	75
Critical Impulse Flashover, Positive, kV			125	155	235	235	235
Low Frequency Puncture Voltage, kV			100	135	215	215	215
Mechanical Strength	Cantilever	Upright, lb	6000	4000	7000	10000	10000
		Underhung, lb	4000	3000	4000	6000	6000
	Torsion, Inch. lb		20000	16000	40000	90000	90000
	Tension, lb.		12000	10000	20000	25000	25000
	Compression, lb		25000	20000	60000	75000	75000
Approximate Net Weight Each, lb			27	33	80	87	114
Standard Package Quantity			4	3	1	1	1

SWITCH and BUS INSULATORS

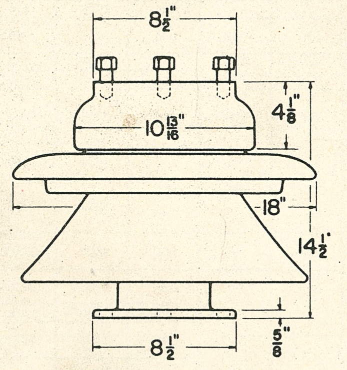
STACKING UNITS

Cap has four 1/2" + 0.015-13UNC-2 tapped holes on 3" bolt circle. Pin has four 9/16" diameter holes on 3" bolt circle. Four cap screws are included.



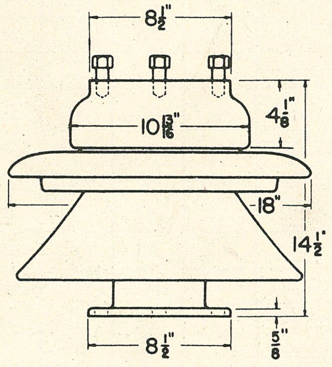
TR No. 147
29511

Cap has four 3/4" + 0.015 -10 UNC-2 tapped holes on 7" bolt circle. Pin has four 13/16" diameter holes on 7" bolt circle. Four cap screws are included.



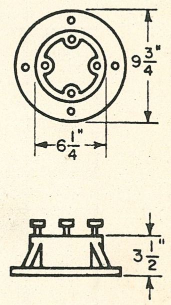
TR No. 142
23083

Cap has four 3/4" + 0.015-10UNC-2 tapped holes on 7" bolt circle. Pin has four 13/16" diameter holes on 7" bolt circle. Four cap screws are included.



TR No. 191
31444

Top flange has four 5/8" + 0.015-11UNC-2 tapped holes on 5" bolt circle. Bottom flange has four 13/16" diameter holes on 8-1/4" bolt circle. Four cap screws are included.



7791

Insulators will be supplied with light gray compression glaze unless specifically ordered with brown glaze.

Locke Catalog Number			29511	23083	31444
Technical Reference Number			147	142	191
BIL Impulse Withstand Voltage, kV			190	210	210
Leakage Distance, inches			26	33	33
Radio Influence Voltage	Test kV to Ground		22	22	22
	Max. µV at 1000 kHz		100	100	100
Low Frequency Withstand Voltage, 10 seconds, wet, kV			70	75	75
Critical Impulse Flashover, Positive, kV			210	235	235
Low Frequency Puncture Voltage, kV			195	215	215
Mechanical Strength	Cantilever	Upright, lb	3000	10000	20000
		Underhung, lb	2000	6000	12000
	Torsion, Inch, lb		15000	90000	120000
	Tension, lb		12000	25000	40000
	Compression, lb		25000	75000	100000
Approximate Net Weight Each, lb			46	117	125
Standard Package Quantity			2	1	1

SWITCH and BUS INSULATORS

STACK CHARACTERISTICS

BIL Impulse Withstand Voltage kV	Suggested Voltage Rating kV	TR No.	No. of Units – Catalog Number	Stack Height in.	Leakage Distance in.	Radio Influence Voltage		Low Frequency Withstand Wet 10 Sec. kV	Critical Impulse Flashover Positive kV	Deflection in. per 100 lb	Mechanical Strength				
						Test kV to Ground	Max. µV at 1000 kHz				Cantilever		Torsion 1000 in. - lb	Tension 1000 lb	Compression 1000 lb
											Upright lb	Under hung lb			
190	- - -	86	2–32200	14½	27	22	100	60	230	- - -	3000	2400	20	12	25
250	- - -	- - -	2–8888	19½	36	42	200	100	305	- - -	1750	1300	16	10	20
	- - -	100	3–32200	21¾	40½	30	200	100	320	- - -	1800	1600	20	12	25
350	69	16	2–29511	29	52	44	200	145	390	.100	1500	1000	15	12	25
		56	2–7785						410	.010	3000	2350	40	20	60
		- - -	1–7785 1–23333		66			160	410	.010	4500	3500	40	20	60
		- - -	2–23333						410	.010	4500	3500	90	25	75
		- - -	2–23082						410	.006	4500	3500	90	25	75
375	69	117	3–8888	29¼	54	56	200	145	425	- - -	975	800	16	10	20
450	- - -	121	4–8888	39	72	70	200	190	525	- - -	675	600	16	10	20
500	115	- - -	2–7785 1–23082	43½	99	73	200	225	550	.025	2900	2350	40	20	60
		19	3–7785						610	.034	1700	1470	40	20	60
550	115	183	2–7785 1–23333	43½	99	73	200	230	610	.034	2900	2350	40	20	60
		173	3–23333						610	.034	2900	2400	90	25	75
		122	3–23082						610	.018	2900	2400	90	25	75
620*	138	- - -	1–30153 1–7785 1–23082	49	102	88	200	265	650	.040	2350	1900	20	15	30
		22	1–30153 2–7785						680		1450	1250			
650	138	180	1–30153 1–7785 1–23333	49	102	88	200	275	680	.050	2350	1900	20	15	30
710*	138/161	- - -	2–7785 2–23082	58	132	103	500	300	770	.060	2000	1750	40	20	60
725*	138/161	26	3–7785 1–23082	58	132	103	500	305	780	.055	1700	1470	40	20	60
750	138/161	25	4–7785	58	132	103	500	315	810	.090	1200	1070	40	20	60
		184	3–7785 1–23333						810	.080	1700	1470	40	20	60
		- - -	2–7785 2–23333						810	.075	2000	1750	40	20	60
		174	4–23333						810	.075	2000	1750	90	25	75
		123	4–23082						810	.040	2000	1750	90	25	75
		- - -	3–23083 1–31444						810	.025	2900	2400	90	25	75
		- - -	4–31444						810	.025	3500	3500	120	40	100
900*	196/230	160	3–7785 2–23082	72½	165	125	500	365	970	.110	1450	1350	40	20	60
900	196/230	126	5–7785	72½	165	125	500	385	1010	.175	910	840	40	20	60
			4–7785 1–23333						1010	.160	1200	1070	40	20	60
		185	3–7785 2–23333						1010	.145	1450	1350	40	20	60
		175	5–23333						1010	.140	1450	1350	90	25	75
		27	5–23082						1010	.080	1450	1350	90	25	75
		- - -	4–23083 1–31444						1010	.050	2000	1750	90	25	75
		- - -	3–23083 2–31444						1010	.050	2750	2400	90	25	75
		- - -	5–31444						1010	.050	2750	2750	120	40	100
1050*	230	161	4–7785 2–23082	87	198	146	500	435	1170	.185	1170	1100	40	20	60
1050	230	128	6–7785	87	198	146	500	455	1210	.320	750	700	40	20	60
		- - -	5–7785 1–23333						1210	.280	910	840	40	20	60
		186	4–7785 2–23333						1210	.255	1170	1070	40	20	60
		176	6–23333						1210	.240	1170	1100	90	25	75
		28	6–23082						1210	.140	1170	1100	90	25	75
		129	6–23083						1210	.090	1170	1100	90	25	75
		- - -	5–23083 1–31444						1210	.090	1450	1350	90	25	75
		- - -	4–23083 2–31444						1210	.090	2000	1750	90	25	75
		196	6–31444						1210	.090	2300	2300	120	40	100
1225*	287	162	4–7785 3–23082	101½	231	180	1000	480	1330	.270	1000	950	40	20	60

SWITCH and BUS INSULATORS

STACK CHARACTERISTICS

BIL Impulse Withstand Voltage kV	Suggested Voltage Rating kV	TR No.	No. of Units – Catalog Number	Stack Height in.	Leakage Distance in.	Radio Influence Voltage		Low Frequency Withstand Wet 10 Sec. kV	Critical Impulse Flashover Positive kV	Deflection in. per 100 lb	Mechanical Strength				
						Test kV to Ground	Max. µV at 1000 kHz				Cantilever		Torsion 1000 in. - lb	Tension 1000 lb	Compression 1000 lb
											Upright lb	Under hung lb			
1300	287/345		7–7785	101½	231	180	1000	525	1410	.500	620	580	40	20	60
			6–7785 1–23333						1410	.460	750	700	40	20	60
			5–7785 2–23333						1410	.410	910	840	40	20	60
		187	4–7785 3–23333						1410	.380	1000	950	40	20	60
		177	7–23333						1410	.380	1000	950	90	25	75
		131	7–23082						1410	.230	1000	950	90	25	75
		133	7–23083						1410	.145	1000	950	90	25	75
			5–23083 2–31444						1410	.145	1450	1350	90	25	75
			4–23083 3–31444						1410	.145	2000	1750	90	25	75
		197	7–31444						1410	.145	2000	2000	120	40	100
1470*		163	5–7785 3–23082	116	264	210	1000	525	1450	.430	900	840	40	20	60
1470			8–7785	116	264	210	1000	590	1610		525	480	40	20	60
			7–7785 1–23333						1610	.710	625	580	40	20	60
			6–7785 2–23333						1610	.640	750	700	40	20	60
		188	5–7785 3–23333						1610	.600	900	840	40	20	60
		178	8–23333						1610	.540	900	860	90	25	75
		136	8–23082						1610	.330	900	860	90	25	75
		135	8–23083						1610	.210	900	860	90	25	75
			6–23083 2–31444						1610	.210	1170	1100	90	25	75
			5–23083						1610	.210	1450	1350	90	25	75
		198	8–31444						1610	.210	1750	1750	120	40	100
1640*		153	9–23083	130½	297	240	2000	650	1810	.290	770	740	90	25	75
			7–23083 2–31444						1810	.290	1000	950	90	25	75
			6–23083 3–31444						1810	.290	1170	1100	90	25	75
			5–23083 4–31444						1810	.290	1450	1350	90	25	75
			9–31444						1810	.290	770	740	120	40	100
1800		157	10–23083	145	330	270	2000	710	2000	.390	680	660	90	25	75
			7–23083 3–31444						2000	.390	1000	950	90	25	75
			6–23083 4–31444						2000	.390	1170	1100	90	25	75
			5–23083 5–31444						2000	.390	1400	1350	90	25	75
			10–31444						2000	.390	1400	1400	120	40	100

*Electrical characteristics of combination stacks involving Cat. No. 7785 (TR 140) and Cat. No. 23082 (TR 141) insulators must be reduced below the established ANSI Standards for stacks of the same height. This is necessary because of the capacitance unbalance that exists between the TR 140 and TR 141 insulators. Where Cat. No. 23333 (TR 139) insulator is used in place of Cat. No. 23082, this unbalance does not exist and the electrical characteristics are equal to ratings of non-mixed stacks.

Withstand voltage values for stacks using Cat. No. 7785, 23333, 23082, 23083, 30153 and 31444 are predicated on the use of 3½'' high sub base No. 7791.

SWITCH and BUS INSULATORS